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cular cylinder intercepted by another right circular cylinder, their axes intersecting at right angles, the two cylinders being equal, and the diameter of each equal to that of the vertical sections of the vault.

$\therefore$ Letting the radius$=a$, $S=8a\int_0^a\int_0^{\sqrt{a^2-x^2}}\frac{dxdy}{\sqrt{a^2-x^2}}=8a^2$, the equations of the cylinders being $x^2+z^2=a^2$, and $x^2+y^2=a^2$.

The volume is equivalent to that of four wedges cut from the cylinder, $x^2+y^2=a^2$, by the planes, $z=0$, and $z=x$.

$$\therefore\ V=8\int_0^a\int_0^{\sqrt{a^2-x^2}}\int_0^x dxdydz=\frac{8a^3}{3}.$$

Also solved by *E. L. SHERWOOD* and *G. B. M. ZERR.*

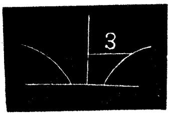
48. Proposed by G. B. M. ZERR, A. M., Ph. D., Professor of Mathematics and Applied Science, Texarkana College, Texarkana, Arkansas-Texas.

I have a circular section basin 12 inches in perpendicular height; the diameters are as follows: At base, 2 inches; one inch perpendicular height, 6 inches; two inches perpendicular height, 18 inches; three inches perpendicular height, 54 inches; and so on, the diameter being trebled for every inch in height. After a rain the water in the basin is six inches deep, what was the rainfall?

I. Solution by E. L. SHERWOOD, A. M., Professor of Mathematics, Mississippi Normal College, Houston, Mississippi; C. W. M. BLACK, A. M., Professor of Mathematics in Wesleyan Academy, Wilbraham, Massachusetts, and the PROPOSER.

The basin is generated by revolving the curve $x=3^y$ about the axis of y.

$$\therefore\ \text{Volume of water}=\pi\int_0^6 x^2dy=\pi\int_0^6 3^{2y}dy.$$



$$\therefore\ V=\pi\cdot\frac{3^{12}-1}{2\log3}=\frac{531440\pi}{2\log3}.$$

Let $x=$depth of rain-fall, then since radius of top of basin$=3^{12}$, $V=\pi3^{24}x$.

$$\therefore\ x=\frac{565720}{282429536481\log3}=.00000086\ \text{inches}.$$

II. Solution by O. W. ANTHONY, M. Sc., Professor of Mathematics in New Windsor College, New Windsor, Maryland.

Call x the length of any radius, and y the vertical distance, y being 1 at the bottom of the basin. Then the equation of side of basin is $x=3^{y-1}$,

$$dV=\pi x^2dy,\ V=\pi\int_1^y 3^{2y-2}dy=\frac{\pi[3^{12}-1]}{3\log_e3}.$$

The radius of upper base$=3^{12}$. Call R the rainfall, then

$$\pi 3.^{24}R=\frac{\pi[3^{12}-1]}{2\log_e 3}. \qquad R=\frac{3^{12}-1}{2.3.^{24}\log_e 3}.$$

Also solved by *A. H. HOLMES*, *J. SCHEFFER*, and *B. F. YANNEY*.

ERRATA. In last issue, page 120, line 4 from bottom, for "$\rho=\frac{\theta^2}{c^2}$" read, $\rho^2=\frac{\theta^2}{c^2}$.

PROBLEMS.

55. Proposed by GEORGE LILLEY, Ph. D., LL. D., Principal of Park School, 394 Hall Street, Portland, Oregon.

A horse is tethered by a rope, a feet long, fastened to a post in a circular fence enclosing a circular piece of ground b feet in diameter. If the horse is outside of the fence over how much ground can he feed? If he is inside the fence over how much ground can he feed? $b>a$ in each case.

56. Proposed by Prof. B. F. BURLESON, Oneida Castle, New York.

Find (1) the length s of the closed curve of the cardioid; (2) its area A; (3) if made to revolve about its axis $2a$, find the maximum longitudinal circumference C of the solid generated; (4) find the surface K of the same; (5) its volume V; (6) the distance x_0 of the center of gravity of the solid from the origin O; and (7) the distance g_0 of the center of gravity of the plane curve from the origin O.

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MECHANICS.

Conducted by B. F. FINKEL, Springfield, Mo. All contributions to this department should be sent to him.

SOLUTIONS OF PROBLEMS.

31. Proposed by O. W. ANTHONY, M. Sc., Professor of Mathematics in New Windsor College, New Windsor, Maryland.

A perfectly elastic, but perfectly rough mass M, and radius R, rotating in a vertical plane with an angular velocity ω, is let fall from a height, a, upon a perfectly elastic but perfectly rough horizontal plane. Determine the motion of the body after striking the plane. What will be its ultimate motion?

II. Solution by G. B. M ZERR, A. M., Ph. D., Professor of Mathematics and Applied Science, Texarkana College, Texarkana, Arkansas-Texas.

Let V be the vertical velocity of the center just before impact; u, v, the horizontal and vertical velocities of the center just after the first impact; ω_1 the